NOTE: The document identifier and heading has been changed on this page to reflect that this is a performance specification. There are no other changes to this document. The document identifier on subsequent pages has not been changed, but will be changed the next time this document is revised.

INCH-POUND

MIL-PRF-39035C 11 October 1991 SUPERSEDING MIL-R-39035B 31 October 1972

PERFORMANCE SPECIFICATION

RESISTOR, VARIABLE, NONWIRE-WOUND (ADJUSTMENT TYPE)
ESTABLISHED RELIABILITY
GENERAL SPECIFICATION FOR

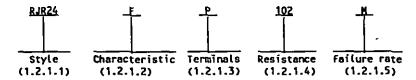
This specification is approved by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers the general requirements for a multiturn lead-screw actuated, and single-turn, nonwire-wound, variable resistors with a contact bearing uniformily over the surface of the entire resistive element, when positioned by an actuator. These resistors are capable of full-load operation (when the maximum resistance is engaged), at a maximum temperature of 150°C, with a resistance tolerance of ±10 percent. The resistors will have life failure rate levels ranging from 1.0 to 0.001 percent per 1,000 hours (see 1.2.1.5). These failure rate levels are established at a 60-percent confidence level maintained at 10-percent producer's risk on the basis of the life tests. The failure rate level, identified by the appropriate symbol, is referred to operation at full rated voltage at 85°C, with a permissible change in resistance of ±5 percent as the criteria for failure. Table I of supplement 1 provides a summary of performance characteristics for these resistors. A part per million (PPM) quality system is used for documenting and reporting the average outgoing quality of resistors supplied to this specification. Statistical process control (SPC) techniques are required in the manufacturing process to minimize variation in production of resistors supplied to the requirements of this specification.

1.2 Classification.

1.2.1 <u>Part or Identifying Number (PIN)</u>. The PIN shall be in the following form, and as specified (see 3.1).



Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Defense Electronics Supply Center, ATTN: DESC-ELDM, 1507 Wilmington Pike, Dayton, OH 45444-5765, by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A
<u>DISTRIBUTION STATEMENT A.</u> Approved for public release; distribution is unlimited.

FSC 5905

- 1.2.1.1 <u>Style</u>. The style is identified by the three letter symbol "RJR" followed by a two-digit number; the letters identify established reliability, adjustment type, nonvire-wound variable resistors, and the number identifies the physical size.
- 1.2.1.2 <u>Characteristic</u>. The characteristic is identified by a single letter which identifies the resistance—temperature characteristic, maximum ambient temperature at rated wattage, and maximum ambient operating temperature (zero load) in accordance with table I.

T		1	i i	
Symbol	Maximum re temperatur (referred	e characteristic	•	Maximum ambient operating temperature
	<u>x •c</u>	PPM	<u>•c</u>	<u>•c</u>
c	±0.025	±250	85 j	150
F	±0.010	±100	85	150
нj	±0.005	±50	8 5	150

TABLE 1. Characteristic.

1.2.1.3 Terminals. The terminals are identified by a single letter in accordance with table II.

Symbol	Type of terminal		
L			
P	Printed-circuit pins.		
W 1/	Printed-circuit pins (edge mounted).		
x 2/	Printed-circuit pins (edge mounted, alternate configuration)		
Y <u>3</u> 7 ⋅ ₃₆	Printed-circuit pins (staggered).		
D 4/ "	Printed-circuit terminals (dual in-line package, four		
	terminals).		

TABLE II. Terminals.

- 1/ Available only in essentially square styles. Pins extend from the edge 180° away from the operating shaft, and are parallel to the longitudinal axis of the operating shaft.
- 2/ Available only in essentially square styles. Pins extend from the edge 90° away from the operating shaft, and are prependicular to the longitudinal axis of the operating shaft.
- 3/ Applicable to style RJR12 only.
- 4/ Applicable to style RJR32 only.
- 1.2.1.4 <u>Resistance</u>. The nominal total value expressed in ohms is identified by a three-digit number; the first two digits represent significant figures and the last digit specifies the number of zeros to follow. The following are examples of symbols for resistance values.

101 = 100 ohms102 = 1,000 ohms

1.2.1.5 <u>Life failure-rate (established at 60-percent confidence)</u>. The life failure rate level designation as shown in table III is signified by a single letter (M, P, R, or S), which identifies the life failure-rate level for which the resistor is qualified (see 4.5).

TABLE III. failure rate designations.

 Failure-rate level designation	Failure rate percent/1,000 hours
<u> </u>	!
[1.0
į P	0.1
į R	j 0.01 j
j <u> s </u>	0.001

1.2.1.6 Example of PIN. The PIN "RJR24 F P 102 M" signifies:

- RJR24 Adjustment type, resistor variable non-wire-wound (established reliability) of the dimensions specified (see 3.1).
- F Having a characteristic signifying a maximum resistance temperature characteristic of ±0.010 percent per °C (±100 PPM) and a capability of operating at rated wattage of 85°C maximum and when derated at 150°C maximum (see figure 2).
- P Having printed circuit pins.
- 102 Having a nominal resistance value of 1,000 ohms.
- M Having a failure rate level of 1.0 percent per 1,000 hours.

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 <u>Specifications, standards, and handbooks</u>. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation (see 6.2).

SPECIFICATION

MILITARY

MIL-R-39032 - Resistors, Packaging of.

STANDARDS

MILITARY

MIL-STD-202	 Test Methods for Electronic and Electrical Component Parts.
MIL-STD-690	 Failure Rate Sampling Plans and Procedures.
MIL-STD-790	 Reliability Assurance Program for Electronic Parts Specifications.
MIL-STD-1285	 Marking of Electrical and Electronic Parts.

(Unless otherwise indicated, copies of federal and military specifications, standards, and handbooks are available from the Standardization Documents Order Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

2.1.2 Non-government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DoD adopted are those listed in the issue of the DODISS listed in the DODISS are the issues of the documents cited in the solicitation (see 6.2). cited in solicitation. Unless otherwise specified, the issues of documents not

ELECTRONIC INDUSTRIES ASSOCIATION (EIA)

- EIA-554 Assessment of Outgoing Nonconforming Levels in Parts Per Million (PPM) (DOD adopted).
 EIA-557 - Statistical Process Control Systems (DOD Adopted).

(Applications for copies should be addressed to the Electronic Industries Association, 2001 Eye Street, Washington DC 20006.)

(Non-Government standards and other publications are normally available from organizations that prepare or distribute the documents. These documents also may may be available in or through libraries or other informational services.)

2.2 Order of precedence. In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REDUIREMENTS

- 3.1 Detail specifications. The individual item requirements shall be as specified herein and in accordance with the applicable detail specification. the event of any conflict between the requirements of this specification and the detail specification, the latter shall govern (see 6.1). Detail specification information is provided in the applicable specification sheet.
- 3.2 Qualification. The resistors furnished under this specification shall be products which are qualified for listing on the applicable qualified products list (QPL) at the time set for opening of bids (see 4.4 and 6.3). In addition, the manufacturer shall obtain certification from the qualifying activity that the reliability assurance requirements of 4.1.1 have been met and are being maintained. Authorized distributors that are approved to MIL-STD-790 requirements by the QPL manufacturer are listed in the QPL.

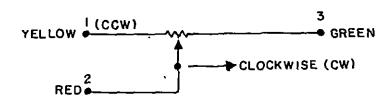
3.3 Reliability and quality.

3.3.1 Reliability. The reliability of resistors furnished under this specification shall be established and maintained in accordance with the requirements and procedures specified in MIL-STD-790 and MIL-STD-690 with details and exceptions specified in 4.1.2, 4.4.4, and 4.6.2.1.

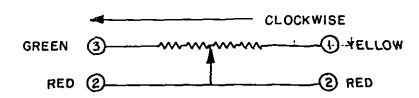
3.3.2 quality.

- 3.3.2.1 Statistical process control (SPC). The contractor shall implement and use SPC techniques in the manufacturing process for parts covered by this specification. The SPC program shall be developed and maintained in accordance with all the requirements of EIA-557. The SPC program shall be documented and maintained as part of the overall reliability assurance program as specified in MIL-STD-790. The implementation of SPC shall be 12 months from the date of this specification. Processes for application of SPC techniques may include but are not limited to:
 - a. Printing of resistance elements.
 - b. Molding operation.
 - c. Lead attachment.
 - d. Assembly.
- 3.3.2.2 Quality levels. The quality of lots that have been subject to and passed the subgroup I, 100 percent screening inspection of the group A inspection shall be established and maintained in accordance with 4.6.1.2 and EIA-554. Individual PPM defect level (i.e., PPM-2 and PPM-3) and an overall PPM defect level (i.e., PPM-5) shall be established based on the tests prescribed in the subgroup 2 tests of the group A inspections. The defect level for PPM-2 shall be less than 100 PPM. The implementation of PPM verification shall be 12 months from the date of this specification.
- 3.3.2.2.1 Noncompliance. The contractor shall notify the qualifying activity when the 100 PPM level is reached or exceeded for PPM-2. The contractor shall provide sufficient information to the qualifying activity documenting the causes of the problem and what corrective action is being taken. Failure to correct this problem shall be the basis for removal of the affected product from the QPL.
- 3.4 Material. The material shall be as specified herein. However, when a definite material is not specified, a material shall be used which will enable the resistors to meet the performance requirements of this specification. Acceptance or approval of any constituent material shall not be construed as a guaranty of the acceptance of the finished product.
- 3.4.1 Plastic. Plastic laminates containing a cotton-fabric base or plastic-molding compounds containing a cotton or wood-flour filler shall not be used. Plastic materials, that have not been machined, shall have the original, smooth, or polished surfaces. Surfaces that have been sawed, cut, punched, or otherwise machined shall be smooth as practicable in accordance with good manufacturing practice for the intended application.
- 3.4.2 Ferrous materials. Unless specifically approved by the Government, the use of ferrous material, with the exception of corrosion-resistant steel and resistance-element material, is prohibited.
- 3.5 Design, construction, and physical dimensions. The resistors shall be of the design, construction, and physical dimensions specified (see 3.1).
- 3.5.1 Resistance element. The resistance element shall be nonwire-wound on a suitable form which shall not char or break down as a result of the tests specified herein. The element shall be characterized by a continuous nature of the surface area, or multiple paths of the resistance element to be contacted. Contact must be made over a continuous and unbroken resistance path.

- 3.5.2 Protective housing or enclosure. The resistance element of completed resistors shall be protected by a housing, or an enclosure, or both, which shall completely cover the exterior of the resistance element. The protective enclosure shall be free from holes, fissures, chips, or other faults, and shall be such as to minimize the establishment of leakage paths between the terminals, resulting from collection of moisture film on the exterior surface of the housing or enclosure. If the housing is made from a metal or metal alloy, it shall be properly protected against corrosion and all fasteners shall be suitably plated. Unplated copper-alloy metals shall not be used in contact with aluminum.
- 3.5.3 Terminals. Terminals shall be as specified in table II. Connections of terminals to the resistance element shall be mechanically strong. All terminals shall be fastened securely. Terminals shall be protected by a corrosion resistant metallic coating, and all terminals or exposed portions of insulated wire shall be suitably treated to facilitate soldering.
 - 3.5.3.1 Terminal identification and circuit diagram.
 - 3.5.3.1.1 Terminal identification.
- 3.5.3.1.1.1 Terminals (applicable to all terminals except L). Terminal identification shall be by one of two methods: The numerals designating terminal identification may be marked adjacent to the terminals, or circuit diagram (see 3.5.3.1.2) may be used, provided that such identification clearly indicates the applicable terminals.
- 3.5.3.1.1.2 Terminal L type resistors. For terminal type L resistors, the insulation of the flexible leads shall be color-coded as shown on figure 1.
- 3.5.3.1.2 Circuit diagram. The circuit diagram shall be marked on any surface of the resistor in a legible manner, as shown on figure 1.
 - 3.5.3.1.3 Legibility. Marking shall remain legible after all tests.
- 3.5.4 Securing of screw-thread assemblies. Screw-thread assemblies shall not loosen as a result of the tests specified herein.
- 3.5.5 Operating shaft. The operating shaft shall be of corrosion-resistant material with the head insulated from all electrical parts of the resistor.
- 3.5.6 Contact-arm assembly. Contact pressure on the resistance element shall be maintained by positive pressure and shall permit smooth electrical and mechanical control of the resistor over the entire range. The moving contact shall have continuous electrical contact with its terminal throughout the entire mechanical travel and shall be insulated from the operating shaft head and case.
 - 3.5.7 Mechanical limits.
- 3.5.7.1 Clutches (applicable only to multiturn adjustment type units, unless otherwise specified (see 3.1)). Clutches shall be furnished to permit the contact arm to idle at either end of the resistance element without electrical or mechanical malfunction (see 3.16.2).
- 3.5.7.2 Stops (applicable to single turn units, unless otherwise specified (see 3.1)). Stops employed to limit the mechanical rotation of the contact arm assembly may be part of, but shall not complete an electrical circuit.



ALL TERMINAL TYPES EXCEPT D



DUAL-IN-LINE TERMINAL TYPE D ONLY

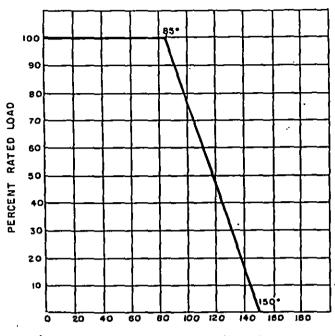
FIGURE 1. Circuit_diagram.

- 3.5.8 <u>Riveting</u>. When riveting is required, the operation shall be carefully performed to insure that the rivets are tight and satisfactorily headed. Riveting shall not be used in assembling two or more current-carrying-parts to an insulating material.
- 3.5.9 Flux and cleaning agents. Flux for soldering of electrical connections shall be resin or resin and alcohol. No acid or acid salts shall be used in preparation for or during soldering; however, exception is permitted for preliminary tinning of electrical connections and for tinning or soldering of mechanical joints not used to complete electrical circuits. Acid or acid salts shall not be used where they can come in contact with insulation material. Where acid or acid salts are used, as permitted herein, they shall be completely neutralized and removed immediately after use.
- 3.5.10 Process. Soldering connections shall be neat. There shall be no sharp points or rough surfaces resulting from insufficient heating. The solder shall feather out to a thin edge, indicating proper flowing and wetting action, and shall not be crystallized, overheated, or underheated. The minimum necessary amount of flux and solder shall be used for electrical connections. Excess resin shall be removed without damage to the solder connection. Insulation material that has been subjected to heating during the solder operation shall be undamaged and parts fastened thereto shall not have become loosened.

- 3.5.11 Solder dip (retinning) leads (not applicable to terminal L). The manufacturer (or his authorized category B or C distributor) may solder dip/retin the leads of product supplied to this specification provided the solder dip process has been approved by the qualifying activity.
- 3.5.11.1 Qualifying Activity Approval. Approval of the solder dip process will be based on one of the following options:
 - a. When the original lead finish qualified was hot solder dip lead finish 52 of MIL-STD-1276 (Note: The 200 microinch maximum thickness is not applicable). The manufacturer shall use the same solder dip process for retinning as is used in the original manufacture of the product.
 - b. When the lead originally qualified was not hot solder dip lead finish 52 of MIL-STD-1276 as prescribed in 3.5.11.1a, approval for the process to be used for solder dip shall be based on the following test procedure:
 - (1) Thirty samples of any resistance value for each style and lead finish are subjected to the manufacturer's solder dip process. Following the solder dip process, the resistors are subjected to the dc resistance test (and other group A electricals). No defects are allowed.
 - (2) Ten of the 30 samples are then subjected to the solderability test. No defects are allowed.
 - (3) The remaining 20 samples are subjected to the resistance to solder heat test followed by the moisture resistance test (or hermetic seal test if the device is hermetically sealed). No defects are allowed.

(Note: Solder dip of gold plated leads is not allowed).

- 3.5.11.2 Solder dip/retinning options. The manufacturer (or authorized category B or C distributor) may solder dip/retin as follows:
 - a. After the 100 percent group A screening tests. Following the solder dip/retinning process, the electrical measurements required in group A, subgroup 1, 100 percent screening tests shall be repeated on 100 percent of the lot (Note: The manufacturer may solder dip/retin prior to the 100 percent electrical measurements of the group A, subgroup 1 tests}. The Percentage Defective Allowable (PDA) for the electrical measurements shall be as for the subgroup 1 tests.
 - b. As a corrective action if the lot fails the group A solderability test.
 - c. After the group A inspection has been completed. Following the solder dip/retinning process, the electrical measurements required in group A, subgroup 1, 100 percent screening test shall be repeated on 100 percent of the lot. The PDA for the electrical measurements shall be as for the subgroup 1 tests. Following these tests, the manufacturer shall submit the lot to the group A solderability test as specified in 4.7.13.
- 3.5.11.3 Welding and brazing. Where welding and brazing is employed, the electrical connections shall be mechanically secure and electrically continuous after welding and brazing. Where brazing is employed only, substantially noncorrosive fluxes shall be used, unless it can be shown that corrosive elements have been satisfactorily removed after brazing.



AMBIENT TEMPERATURE IN CELSIUS

FIGURE 2. Derating curve for high-ambient temperatures.

3.6 <u>Power rating</u>. The resistors shall have a power rating based on continuous full-load operation at the ambient temperature specified (see 3.1 and figure 2). The power rating is dependent on the ability of the resistors to meet the life requirements specified in 3.30. For temperatures in excess of those specified, the load shall be derated as shown on figure 2. Power ratings as specified (see 3.1), are applicable only when the maximum resistance resistance is engaged in the circuit. The power rating is reduced in approximately the same proportion as the resistance.

3.7 Yoltage rating. The theoretically calculated rated continuous working voltage or the voltage equivalent to power rating (rated wattage) shall be determined from the following formula:

$$E = \sqrt{PR}$$

Where: E = Rated dc or rms ac continuous working voltage at commerical-line frequency and waveform.

P = Power rating (see 3.1).
R = Nominal resistance (see 3.1).

In no case shall the rated dc or rms continuous working voltage be greater than the applicable maximum value (see 3.1).

3.8 <u>Conditioning</u>. When resistors are tested as specified in 4.7.2, there shall be no mechanical damage. The change in total resistance shall not exceed #2 percent for characteristic C, *1.5 percent for characteristic F, and ±1 percent for characteristic H.

- 3.9 Contact resistance variation. When measured as specified in 4.7.3, the contact resistance variation shall not exceed *3 percent or 20 ohms for characteristic C, and *3 percent or 3 ohms for characteristics F and H, which ever is greater.
- 3.10 Integrity of shaft (not applicable to style RJR32). When resistors are tested as specified in 4.7.4, there shall be no evidence of shaft breakage, and the shaft shall remain in one piece.

3.11 DC resistance.

- 3.11.1 Total resistance. When measured as specified in 4.7.5.1, the total direct current (dc) resistance shall not deviate from the specified nominal resistance (see 3.1), by more than ±10 percent.
- 3.11.2 End resistance. When measured as specified in 4.7.5.2, the end resistance for all characteristics shall not exceed 2 ohms or *2 percent of the total resistance, which ever is greater.
- 3.12 Immersion (not applicable to L terminals). When resistors are tested as specified in 4.7.6, no continuous stream of bubbles shall emanate from any concentrated point of the resistor. When resistors are subjected to the dye penetrant test, there shall be no evidence of dye in the internal cavities.
- 3.13 Actual effective electrical travel. When resistors are tested as specified in 4.7.7, the number of turns of the operating shaft necessary for the contact arm to traverse the resistance element shall be as specified (see 3.1).
- 3.14 Dielectric withstanding voltage. When resistors are tested as specified in 4.7.8, there shall be no evidence of damage, arcing, or breakdown. The leakage current shall not exceed one milliampere.
- 3.15 <u>Insulation resistance</u>. When resistors are tested as specified in 4.7.9, the dry <u>insulation resistance</u> shall not be less than 1,000 megohms.

3.16 <u>Torque</u>.

- 3.16.1 Operating. When resistors are tested as specified in 4.7.10.1, the minimum torque required to move the contact arm shall be 0.05 ounce-inch and the maximum torque required shall be as specified (see 3.1).
- 3.16.2 Clutch (applicable only to multiturn adjustment type units, unless otherwise specified). When resistors are tested as specified in 4.7.10.2, the contact arm shall idle against the stop without electrical discontinuity or evidence of mechanical damage. The travel of the arm shall also be capable of reversing direction.
- 3.16.3 Stops (applicable only to single turn units, unless otherwise specified). When resistors are tested as specified in 4.7.10.3, they shall withstand the top torque specified (see 3.1), without damage to the contact arm or stop.
- 3.17 Thermal shock. When resistors are tested as specified in 4.7.11, the change in total resistance shall not exceed ±2 percent for characteristic C, and ±1 percent for characteristics F and H. The change in setting stability shall not exceed ±1 percent. There shall be no electrical discontinuity or evidence of mechanical damage.
- 3.18 Solderability (not applicable to terminal L). When resistors are tested as specified in 4.7.13, they shall meet the criteria for wire-lead terminal evaluation in the test method.

- 3.19 <u>Resistance-temperature characteristic</u>. When resistors are tested as specified in 4.7.14, the resistance-temperature characteristics shall be refer to an ambient temperature of 25°C. Resistors shall not exceed the applicable values specified in table I.
- 3.20 <u>Moisture resistance</u>. When resistors are tested as specified in 4.7.15, resistors shall meet the following requirements:

```
Total resistance - - - - - - - Change shall not exceed ±2 percent for characteristic C, and ±1 percent for characteristics F and H.

Insulation resistance - - - - Shall not be less than 100 megohms.

Visual examination - - - - - - - There shall be no evidence of mechanical damage.
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- 3.21 Setability. When resistors are tested as specified in 4.7.16, the setability shall be ±1 percent maximum.
- 3.22 Shock (specified pulse). When resistors are tested as specified in 4.7.17, the change in total resistance shall not exceed ±1 percent. The change in setting stability shall not exceed ±1 percent. There shall be no electrical discontinuity or evidence of mechanical damage.
- 3.23 <u>Vibration, high frequency</u>. When resistors are tested as specified in 4.7.18, there shall be no electrical discontinuity, and resistors shall meet the following requirements:

```
Setting stability - - - - - Change shall not exceed 1 percent.

Total resistance - - - - - Change shall not exceed ±1 percent.

Visual examination - - - - - There shall be no evidence of mechanical damage.
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- 3.24 <u>Salt spray (corrosion)</u>. When resistors are tested as specified in 4.7.19, there shall be no appreciable corrosion which will affect the life or serviceability. If the base metal is corroded, it shall be considered a defect.
- 3.25 <u>Resistance to soldering heat</u>. When resistors are tested as specified in 4.7.20, the change in total resistance shall not exceed ±1 percent. There shall be no evidence of mechanical damage.
- 3.26 <u>Low temperature operation</u>. When resistors are tested as specified 4.7.21, resistors shall meet the following requirements:

```
Setting stability ----- Change shall not exceed 2 percent.

Total resistance ----- Change shall not exceed ±2 percent for characteristic C, and ±1 percent for characteristics F and H.

Visual examination ----- There shall be no evidence of mechanical damage.
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3.27 <u>High temperature exposure</u>. When tested as specified in 4.7.22, resistors shall meet the the following requirements:

```
Setting stability - - - - - - Change shall not exceed 2 percent.

Total resistance - - - - - Change shall not exceed ±3 percent.

Dielectric withstanding
voltage - - - - - - - As specified in 3.13.

(atmospheric pressure)

Insulation resistance - - - - Shall not be less than 1,000 megohms.

Visual examination - - - - - There shall be no evidence of mechanical damage.
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- 3.28 <u>Rotational life</u>. When resistors are tested as specified in 4.7.23, the change in total resistance shall not exceed ±2 percent, and there shall be no mechanical damage. The failure of one pair of units being tested shall not count as a failure for the companion unit.
- 3.29 <u>Terminal strength</u>. When resistors are tested as specified in 4.7.24, there shall be no evidence of mechanical damage, and resistors shall be electrically continuous.
 - 3.30 Life.
- 3.30.1 <u>Qualification</u>. When resistors are tested as specified in 4.7.25, there shall be no evidence of mechanical damage. The change in resistance between the initial measurement and any of the succeeding measurements shall not exceed ±3 percent.
- 3.30.2 <u>Failure-rate level determination</u>. When resistors are tested as specified in 4.7.25, there shall be no evidence of mechanical damage to the resistance element, or enclosure. The change in resistance between the initial measurement and any of the succeeding measurements shall not exceed ±5 percent. This single failure criteria shall be applicable to all measurements during the life test for purposes of determining failure rate level qualification and is applicable as a parallel requirement with 3.30.1 to the measurements made during the life test specified for the qualification inspection.
- 3.31 <u>Resistance to solvents</u>. When resistors are tested as specified in 4.7.26, there shall be no evidence of mechanical damage and the markings shall remain legible.
- 3.32 Low temperature storage (qualification only). When resistors are tested as specified in 4.7.27, the change in total resistance shall not exceed ±2 percent for characteristic C, and ±1 percent for characteristics F and H.
 - 3.33 Marking.
- 3.33.1 <u>Full marking</u>. Resistors shall be marked with the PIN (see 3.1), and "JAN" brand. In addition, the resistor shall be dated and source coded in accordance with MIL-STD-1285. Where the date coding does not provide specific lot identification, the manufacturer shall mark the resistor with the lot code symbol. Where required, the PIN may appear on two lines as shown in the following example:

RJR24F P102M

Marking shall remain legible at the end of all tests.

3.33.2 <u>Minimum marking</u>. When the physical size of the resistor style precludes the marking of the information required by 3.33.1, the minimum marking shall be as specified in the detail specification (see 3.1). Marking shall remain legible at the end of all tests. In those cases where full marking requirements are not on the resistor body, the full marking shall be marked on the unit package.

- 3.33.3 JAN and J marking. The United States Government has adopted, and is exercising legitimate control over the certification marks "JAN" and "J", respectively, to indicate that items so marked or identified are manufactured to, and meet all the requirements of military specifications. Accordingly, items acquired to, and meeting all of the criteria specified herein and in applicable specifications shall bear the certification mark "JAN" except that items too small to bear the certification mark "JAN" shall bear the letter "J". The "JAN" or "J" shall be placed immediately before the PIN except that if such location would place a hardship on the manufacturer in connection with such marking, the "JAN" or "J" may be located on the first line above or below the PIN. Items furnished under contracts or orders which either permit or require deviation from the conditions or requirements specified herein or in applicable specifications shall not bear "JAN" or "J". In the event an item fails to meet the requirements of this specification and the applicable specification sheets or associated detail specifications, the manufacturer shall remove the "JAN" or the "J" from the sample tested and also from all items represented by the sample. The "JAN" or "J" certification mark shall not be used on products acquired to contractor drawings or specifications. The United States Government has obtained Certificate or Registration Number 504,860 for the certification mark "JAN".
- 3.33.4 Supplying to higher FR levels. A manufacturer may supply to all higher failure rate levels than that to which he is qualified. Parts qualified and marked to lower failure rate levels, with procuring agency approval, are substitutable for higher rate level parts, and shall not be remarked unless specified in the contract or purchase order (see 6.2 and table IV).

TABLE IV. Failure rate substitution.

Failure rate	Failure rate substitution
S (.001)	s
R (.01) P (0.1) M (1.0)	S, R S, R, P S. R. P. M

3.33.5 Supplying to higher resistance temperature characteristics. Parts qualified and marked to lower resistance temperature characteristics, with procuring agency approval, are substitutible for higher resistance temperature characteristics and shall not be remarked unless specified in the contract or purchase order (see 6.2 and table V).

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TABLE V. Characteristic substitution.

Characteristic		 Characteristic substitution
 Symbol	\$/*C	1 }
 H F C	±50 ±100 ±250	H H, F H, F, C

3.34 Workmanship. Resistors shall be processed in such a manner as to be uniform in quality and shall be free from holes, fissures, chips, and malformation. The leads shall be unbroken and not crushed or nicked, and the resistors shall be free from other defects that will affect life, serviceability, or appearance.

4. QUALITY ASSURANCE PROVISIONS

- 4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements (examinations and tests) as specified herein. Except as otherwise specified in the contract or purchase order, the contractor way use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set fourth in the specification where such inspections are deemed necessary to ensure supplies and services conform to prescribed requirements.
- 4.1.1 Responsibility for compliance. All items shall meet all requirements of sections 3 and 5. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of ensuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling inspection, as part of manufacturing operations, is acceptable practice to ascertain conformance to requirements, hower, this does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to accept defective material.
- 4.1.2 Reliability assurance program. A reliability assurance program shall be established and maintained in accordance with MIL-STD-790. Evidence of such compliance shall be verified by the qualifying activity of this specification as a prerequisite for qualification and continued qualification.
- 4.1.3 Statistical process control. A SPC program shall be established and maintained in accordance with EIA-557. Evidence of such compliance shall be verified by the qualifying activity as a prerequisite for qualification and retention of qualification.
- 4.2 Classification of inspections. Inspection requirements specified herein are classified as follows:
 - a. Qualification inspection (see 4.4).
 - b. Verification of qualification (see 4.5).
 - c. Quality conformance inspection (see 4.6).
 - 4.3 Inspections, conditions and precautions.
- 4.3.1 Inspection. Unless otherwise specified herein, all inspections shall be performed in accordance with the test conditions specified in the "GENERAL REQUIREMENTS" of MIL-STD-202.
- 4.3.2 <u>Precautions</u>. Adequate precautions shall be taken during inspection to prevent condensation of moisture on resistors. Precautions shall also be taken to prevent damage by heat when soldering resistor leads to terminals.
- 4.4 <u>Qualification inspection</u>. Qualification inspection shall be performed at a laboratory acceptable to the Government (see 6.3), on sample units produced with equipment and procedures normally used in production.

- 4.4.1 Sample. The number of sample units comprising a sample of resistors to be submitted for qualification inspection shall be as specified in the appendix to this specification. The sample shall be taken at random from a production run and shall be produced with equipment and procedures normally used in production. Each resistor style shall be qualified separately.
- 4.4.2 Test routine (see 30.1). Sample units shall be subjected to the qualification inspection specified in table YI, in the order shown. Sample test routine shall be as indicated in the appendix. The qualification of other than "P" type terminals shall be only applicable at the time of the original submission (see appendix). The manufacturer shall not submit all of one terminal type at original submission and request qualification extension to a different terminal by partial submission at a later date. The qualification life sample shall be continued on test for 10,000 hours. The requirement of 3.30.2 shall apply for failure rate data accumulation.
- 4.4.3 <u>Defectives</u>. Defective specimens in excess of the quantities allowed in table VI shall be cause for refusal to grant qualification.

TABLE VI. Qualification inspection. 1/

Inspection	Requirement paragraph	Test method paragraph	Number of sample units to be inspected 2/	Number of defectives allowed 3
Group I Conditioning 4/ Contact resistance	3.8	4.7.2		i ! !
variation $\frac{4}{-}$ Immersion $\frac{4}{-}$	3.9 3.12	4.7.3 4.7.6	∬ All sample units	l N/A
examination $4/5/$	3.4 to 3.5.11 fncl, and	4.7.1		[N/A
Actual effective	3.33 to 3.34 fncl. 		All sample	! ! ! 0
electrical travel 4/ - End resistance 4/ Dielectric withstanding voltage 4/	3.13 3.11.2 1	4.7.7	Cunits except for group II	!
Insulation resistance 4/ Torque 4/ Thermal shock 4/		4.7.8 4.7.9 4.7.10 4.7.11		!
Group II Solderability	3.18	4.7.13	 6 any value 	!
Group III Resistance temperature characteristic Moisture resistance Contact resistance	3.19 3.20	4.7.14 4.7.15	 	1
variation	3.9	4.7.3	<u> </u>	

See footnotes at end of table.

TABLE VI. Qualification inspection 1/ - Continued.

Inspection	Requirement paragraph	Test method paragraph	Number of sample units to be inspected 2/	Number of defectives allowed 3/
Group IV Setability Shock (specified pulse) - Yibration, high frequency Contact resistance variation Salt spray (corrosion) -	3.21 3.22 3.23 3.9 3.24	4.7.16 4.7.17 4.7.18 4.7.3 4.7.19	12 6 highest 6 lowest	1
Group V Resistance to soldering heat	3.25 3.26 3.32 3.27 3.9 3.10	4.7.20 4.7.21 4.7.27 4.7.22 4.7.3 4.7.4	12 6 highest 6 lowest	1 > 1
Group VI Rotational life Contact resistance	3.28 3.9 3.29	4.7.23 4.7.3 4.7.24	12 6 highest 6 highest	
Group VII Life Group VIII. Resistance to solvents -	3.30	4.7.25 4.7.26	102 51 highest 51 lowest 4 any value	1

 $[\]frac{1}{2}$ Group I tests need not be performed if manufacturer presents certified data proving that tests have been previously performed on the qualification sample units.

2/ See appendix for details.

4/ Nondestructive tests.

4.4.4 FR qualification. FR qualification shall be in accordance with the general and detail requirements of MIL-STD-690 and the following details:

- a. Procedure I Qualification at the initial FR level. Level M (1.0 percent) of FRSP-60 shall apply. Sample units shall be subjected to the qualification inspection specified in group YII of table YI (see 4.4.2). Entire life test sample shall continue on test to 10,000 hours as specified in 4.7.25, upon completion of the 2,000 hour qualification.
- b. Procedure II Extension of qualification to lower FR levels. To extend qualification to the R level (0.01 percent) and S (0.001 percent) FR levels, data from two or more styles of similar construction may be combined.

^{3/} Failure of one resistor in one or more tests of a group shall be charged as single defective.

^{5/} Marking shall be considered defective only if illegible or missing.

- c. Procedure III Maintenance of FR level qualification. Maintenance period B of FRSP-10 shall apply. Regardless of the number of production lots produced during this period, the specified number of unit hours shall be accumulated to maintain qualification (see 4.6.2.1). For FR levels M. P. R. and S data from all lead types may be combined.
- 4.4.5 Quality level verification. The contractor is responsible for establishing a quality system to verify the PPM level of lots that are subjected to subgroup 2 tests of group A inspections. The PPM defect level shall be based on a 6-month moving average. The contractor shall verify and report monthly on individual PPM categories (i.e., PPM-2 and PPM-3) and an overall PPM defect level (i.e., PPM-5).
- 4.5 Verification of qualification. Every six months, the manufacturer shall compile a summary of the results of quality conformance inspections and extended failure rate (FR) data, in the form of a verification of qualification report, and forward it to the qualifying activity within 30 days after the end of the reporting period as the basis of continued qualification approval. In addition, the manufacturer shall immediately notify the qualifying activity whenever the FR data indicates that the manufacturer has failed to maintain the qualified FR level, or the group B inspection data indicates failure of the qualified product to meet the requirements of this specification. Continuation shall be based on evidence that over the 6-month period, the following has been met:
 - a. Verification by the qualifying activity that the manufacturer meets the requirements of MIL-STD-790.
 - b. The manufacturer has not modified the design of the item.
 - c. The specification requirements for the item have not been amended so far as to affect the character of the item.
 - d. Lot rejection for group A inspection does not exceed 15 percent or one lot, whichever is greater.
 - e. The requirements for group B inspection are met.
 - f. The records of FR tests combined substantiate that the "M" (1.0 percent), or "P" (0.1 percent) FR level has been maintained, or that the manufacturer continues to meet the "R" (0.01 percent), and "S" (0.001 percent) FR level for which qualified, although the total component hours of testing does not, as yet meet the requirements of 4.4.4c.
 - g. The contractor shall provide documentation to the qualifying activity pertaining to PPM calculations including numbers of part types tested, individual PPM defect categories (i.e., PPM-2 and PPM-3) and the overall PPM defect rate (PPM-5). This information shall be submitted on a detail specification basis and based on a 6-month moving average.

When group B requirements were not met and the manufacturer has taken corrective action satisfactory to the Government, group B testing shall be instituted. A summary of the retesting shall be forwarded to the qualifying activity within 30 days after completion of the retest. All reports shall be certified by a responsible company official and the government inspector.

If group B test requires a comparison of "post-test" readings with initial readings (delta measurements), the verification of qualification summary shall include the maximum and minimum delta changes for each inspection lot. For life testing, delta R readings shall be reported at each interval in which readings are taken.

- 4.6 Quality conformance inspection.
- 4.6.1 <u>Inspection of product for delivery</u>. Inspection of product for delivery shall consist of group A inspection. Delivery of shipment shall not be delayed pending completion of group B inspection.
 - 4.6.1.1 Inspection and production lot.
- 4.6.1.1.1 <u>Inspection lot</u>. An inspection lot as far as practicable, shall consist of all resistors of the same style and characteristic, regardless of the resistance value (combining of all terminal types except L is acceptable) produced in a period not to exceed 30 days, produced under essentially the same conditions, and offered for inspection at one time.
- 4.6.1.1.2 <u>Production Lot</u>. A production lot shall consist of resistors of the same style, nominal resistance value, resistance temperature characteristic, and terminal style. Manufacture of all parts in the lot shall have been started, processed, assembled, and tested as a group. Lot identity shall be maintained throughtout the manufacturing cycle.
- 4.6.1.2 Group A inspection. Group A inspection shall consist of the examinations and tests specified in table VII, and shall be made on the same set of same units, in the order shown.
- 4.6.1.2.1 <u>Subgroup 1 tests</u>. Subgroup 1 test shall be performed on a production lot basis on 100 percent of the product supplied under this specification. Resistors that are out of resistance tolerance, or which experience a change in resistance greater than that permitted for the tests of this subgroup shall be removed from the lot. Only lots having not more than 10-percent rejects or one resistor, whichever is greater due to exceeding the specified resistance change limit, as a result of subgroup 1 tests shall not be furnished on orders. Corrective action shall be taken on such values and new pieces furnished.
- 4.6.1.2.2 <u>Manufacturer's production inspection</u>. If the manufacturer performs tests equal to or more stringent than those specified in subgroup 1, table VII, as the final step of this production process, group A, subgroup 1 inspection may be waived and the data resulting from the manufacturer's production tests may be used instead. Authority to waive the subgroup 1 inspection shall be granted by the qualifying activity only. The following criteria must be complied with:
 - a. Tests conducted by the manufacturer during production shall be clearly identical to or more stringent than that specified for subgroup 1. Test conditions shall be equal to or more stringent than those specified for subgroup 1.
 - b. Manufacturer subjects 100 percent of the product supplied under this specification to his production tests.
 - c. The parameters measured and the failure criteria shall be the same or more stringent than that specified herein.
 - d. The lot rejection criteria is the same or more stringent than that specified herein.
 - e. The manufacturer shall make available all information concerning the test procedures and instrumentation used in his production tests. This data shall be provided as part of the evaluation required for MIL-STD-790. The manufacturer shall also make available to the Government all records of all detail test data resulting from production tests.
 - f. Once approved, the manufacturer shall not change the test procedures or criteria without prior notification and concurrence by the qualifying activity.

TABLE VII. Group A inspection.

Examination or test	Requirement paragragh		Sampling procedure
Subgroup 1 Conditioning Contact resistance variation Immersion	3.8 · 3.9 3.12	4.7.2 4.7.3 4.7.6	100 percent inspection
Subgroup 2 (PPM) DC resistance (PPM-2)- Mechanical (PPM-3) (dimensions only)	3.11	4.7.5 4.7.1	See 4.6.1.2.3.1 See 4.6.1.2.3.2
Subgroup 3 Visual examination	3.33 and 3.34	4.7.1	See 4.6.1.2.4
Subgroup 4 End resistance Actual effective electrical travel - Dielectric withstanding voltage Insulation resistance Torque Thermal shock	 	4.7.5.2 4.7.7 4.7.8 4.7.9 4.7.10 4.7.11	See 4.6.1.2.5
Subgroup 5 Resistance to. soldering heat Immersion	3.25 3.12	4.7.20 4.7.6	See 4.6.1.2.6
Subgroup 6 Solderability	3.18	4.7.13	See 4.6.1.2.7

4.6.1.2.3 Subgroup 2 tests (PPM categories).

4.6.1.2.3.1 PPM-2. Subgroup 2 tests shall be performed on an inspection lot basis. Samples subjected to subgroup 2 shall be selected in accordance with table YIII based on the size of the inspection lot, (Note: Larger samples may be inspected by the contractor in order to calculate PPM, however rejection of the lot shall be based on 1 or more defects.) In the event of 1 or more failures the lot shall be rejected. Equipment used to perform the subgroup 2 tests shall not be the same as those used in the subgroup 1, 100 percent tests.

4.6.1.2.3.2 PPM-3. Statistical sampling inspection shall be performed on an inspection lot basis. A sample of 13 parts shall be randomly selected, if one or more defects are found, the lot shall be rescreened and defects removed. A new sample of 13 parts shall be randomly selected. If one or more defects are found in this second sample, the lot shall be rejected and shall not be supplied to this specification.

- 4.6.1.2.3.3 <u>Rejected Lots</u>. The rejected Lot shall be segregated from new Lots and those Lots that have passed inspection. The rejected Lot shall be 100 percent inspected for those quality characteristics found defective in the sample and any defects found removed from the Lot. A new sample of parts shall be randomly selected in accordance with Table VIII. If 1 or more defects are found in this second sample, the Lot shall be rejected and shall not be supplied to this specification.
- 4.6.1.2.3.4 <u>PPM calculations</u>. PPM calculations shall be based on the results of the first sample check as prescribed in 4.6.1.2.3.1 and 4.6.1.2.3.2. Calculations and data exclusion shall be in accordance with EIA-554. (Note: PPM calculations shall not use data on the second sample submission).
- 4.6.1.2.4 <u>Subgroup 3</u>. Statistical sampling inspection shall be performed on an inspection lot basis. A sample of 13 parts shall be randomly selected, if one or more defects are found, the lot shall be rescreened and defects removed. A new sample of 13 parts shall be randomly selected. If one or more defects are found in this second sample, the lot shall be rejected and shall not be supplied to this specification.
- 4.6.1.2.5 <u>Subgroup 4.</u> Statistical sampling inspection shall be performed on an inspection lot basis. A sample of 13 parts shall be randomly selected, if one or more defects are found, the lot shall be rescreened and defects removed. A new sample of 13 parts shall be randomly selected. If one or more defects are found in this second sample, the lot shall be rejected and shall not be supplied to this specification. These tests are considered destructive and samples submitted to the these tests shall not be supplied on the contract.

Lot size Sample size for PPM-2

0 - 32 100 percent

33 - 125 100 percent

126 - 3,200 125

3,201 - 10,000 200

10,001 - 35,000 315

TABLE VIII. Sampling plans for PPM categories.

4.6.1.2.6 <u>Subgroup 5</u>. Statistical sampling inspection shall be performed on an inspection lot basis. A sample of 13 parts shall be randomly selected, if one or more defects are found, the lot shall be rescreened and defects removed. A new sample of 13 parts shall be randomly selected. If one or more defects are found in this second sample, the lot shall be rejected and shall not be supplied to this specification. These tests are considered destructive and samples submitted to the these tests shall not be supplied on the contract.

4.6.1.2.7 Subgroup 6 (solderability).

...

4.6.1.2.7.1 <u>Sampling plan</u>. Thirteen samples shall be selected randomly from each inspection lot and subjected to the subgroup 6 solderability test, if one or more defects are found, the lot shall be rescreened and defects removed. A new sample of 13 parts shall be randomly selected, if one or more defects are found in the second sample, the lot shall be rejected and shall not be supplied to this specification.

- 4.6.1.2.7.1.1 Rejected lots. In the event of one or more defects, the inspection lot is rejected. The manufacturer may use one of the following options to rework the lot:
 - a. Each production lot that was used to form the failed inspection lot shall be individually submitted to the solderability test as required in 4.7.13. Production lots that pass the solderability test are available for shipment. Production lots failing the solderability test can be reworked only if submitted to the solder dip procedure in 4.6.1.2.7.1.1b.
 - b. The manufacturer submits the failed lot to a 100 percent solder dip using an approved solder dip process as specified in 3.5.11. Following the solder dip the electrical measurements required in group A, subgroup 1 tests shall be repeated on 100 percent of the lot. The PDA for the electrical measurements shall be as for the subgroup 1 tests. Thirteen additional samples shall be selected and subjected to the solderability test with zero defects allowed. If the lot fails this solderability test, the lot shall be considered rejected and shall not be furnished against the requirements of this specification.
- 4.6.1.2.7.1.2 <u>Disposition of samples</u>. The solderability test is considered a destructive test and samples submitted to the solderability test shall not be supplied on the contract.
- 4.6.2 <u>Periodic inspection</u>. Periodic inspection shall consist of group 8 inspection. Except where the results of this inspection show noncompliance with the applicable requirements (see 4.6.2.1.3), delivery of products which have passed group A inspection shall not be delayed pending the results of periodic inspection.
- 4.6.2.1 <u>Group B inspection</u>. Group B inspection shall consists of the examinations and tests specified in table IX, in the order shown. They shall be performed on samples from lots which have been subjected to and passed the group A inspection. Sample sizes and rejects shall be as indicated for the applicable group in table IX.
- 4.6.2.1.1 Quarterly (subgroup I). Samples shall be accumulated from each inspection lot and placed on extended life of 4.7.24 for the full 10,000 hour life test. A sufficient number of samples shall be selected from each lot by the manufacturer so that the maintenance of failure rate requirements are complied with within the specified maintenance period. In any event, a minimum of 5 samples shall be selected from each lot. As far as practicable, the manufacturer shall select the resistance values so that all resistance decades produced during the maintenance period are represented. The accumulated data shall be used for maintenance of extension of failure rate qualification.
- 4.6.2.1.2 <u>Disposition of sample units</u>. Sample units which have been subjected to group B inspection shall not be delivered on the contract or purchase order.
- 4.6.2.1.3 <u>Moncompliance</u>. If a sample fails to pass group B inspection, the manufacturer shall notify the qualifying activity and the cognizant inspection activity of such a failure and take corrective action on the materials or processes, or both, as warranted, and on all units of production which can be corrected and which were manufactured under essentially the same materials and processes, and which are considered subject to the same failure. Acceptance and shipment of the product shall be discontinued until corrective action has been taken. Group B inspection shall be repeated on additional sample units (all inspections, or the inspection which the original sample failed, at the option of the qualifying activity). Groups A inspection may be reinstituted; however, final acceptance and shipment shall be withheld until the group B inspection has shown that the corrective action was successful. In the event of failure after reinspection, information concerning the failure shall be furnished to the cognizant inspection activity and the qualifying activity.

TABLE IX. Group B inspection.

				
Examination or test	Requirement	Method	 Number of samples	Number of defectives
Quarterly Subgroup I	3.30	4.7.25	 See	See
Subgroup 2	,		4.6.2.1.1	4.6.2.1.1
Resistance temperature characteristic	3.19	4.7.14	1)12 (ן . ו ^י
			12-6 highest	
Moisture resistance 1/- Contact resistance	3.20	4.7.15	6 lowest	!} !
variation	3.9	4.7.3	 	$\left \int_{-1}^{1} \left \int_{-1}^{1} $
Subgroup 3		j	'n	is b
Rotational life	3.28	4.7.23	11]
Contact resistance			112-6 highest	
]_ variation	3.9	4.7.3	16	i (
Terminal strength	3.29	4.7.24	[] 6 lowest	[] [
Semiannually Subgroup 1		 		
Resistance to soldering		1	L	
heat	3.25	4.7.20	וו	1
Low temperature	•	ĺ	1	ו ו
operation	3.26	4.7.21	12-6 highest	i 1
High temperature		ì	1 6 lowest	i 1 - 1
exposure	3.27	4.7.22	1>	il
Contact resistance		i	il	i≻ I ı
variation	3.9	4.7.3	i l	i
Integrity of shaft	3.10	4.7.4	il .	{
1]	j	リ	il L
Setability		1 -	_	Ú (
	3.21	4.7.16	1)	n
Shock (specified pulse)	3.22	4.7.17	12-6 highest	1
Vibration, high		S	1 6 lowest	11 1
frequency	3.23	4.7.18	H .	1
Contact resistance		!	<u> </u>	l (
variation	3.9	4.7.3	'n	!
Subgroup 3 Resistance to solvents-	3.31	 4.7.26	 4 any value	ر را ه ا
Annually Annually Salt spray (corrosion)	3.24] 4.7.19	 4 any value	 0

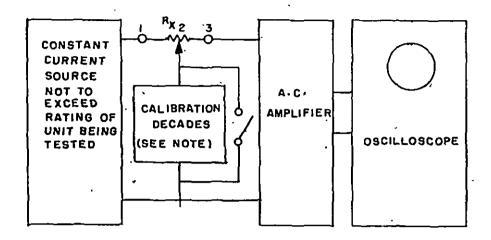
 $[\]underline{1}/$ Every six months, test duration shall be 20 cycles.

4.7 Methods of inspection.

^{4.6.3} Inspection of packaging. The sampling and inspection of the preservation, packing, and container marking shall be in accordance with the requirements of MIL-R-39032.

^{4.7.1 &}lt;u>Visual and mechanical examination</u>. Resistors shall be examined to verify that the materials, design, construction, physical dimensions, marking, and workmanship are in accordance with the applicable requirements (see 3.1, 3.3, to 3.3.2 inclusive, 3.4 to 3.5.11 inclusive, and 3.33 to 3.34 inclusive).

- 4.7.2 Conditioning (see 3.8). Resistors shall be conditioned in accordance with method 108 of MIL-STD-202. The following details and exceptions shall apply:
 - a. Method of mounting Supported by their terminals (resistors not mounted on life test chassis). Resistors shall be so arranged that the temperature of any one resistor shall not appreciably influence the temperature of any other resistor. There shall be no undue draft on the resistors.
 - b. Temperature and tolerance Standard test condition (see 4.3.1).
 - c. Initial measurements Initial total resistance shall be measured after mounting as specified in 4.7.5.1. This initial measurement shall be used as the reference temperature for all subsequent measurements.
 - d. Operating condition DC continuous working voltage or a continuous working voltage from an ac supply at commercial line frequency and waveform equivalent to 1.5 times the specified wattage (see 3.1), shall be applied between the end terminals intermittently 1.5 hours "on" and 0.5 hour "off" for a minimum of 50 hours +8, -0 hours at a temperature of 25°C, +10, -0°C. Each resistor shall dissipate 1.5 times the rated wattage, but not to exceed the maximum rated voltage (see 3.1).
 - e. Measurement after conditioning Total resistance shall be measured at the end of the 50 +8, -0 hours as specified in 4.7.5.1 after load has been removed and the resistors stabilized.
 - f. Examination after conditioning Resistors shall be examined for evidence of mechanical damage.
 - 9. Test duration 50 +8, -0 hours minimum.
- 4.7.3 Contact resistance variation (see 3.9). Contact resistance variation shall be measured with the measuring circuit shown on figure 3, or its equivalent. The operating shaft shall be rotated in both directions through 90 percent of the actual effective-electrical travel for a total of 6 cycles. Only the last 3 cycles shall count in determining whether or not a contact resistance variation is observed at least twice in the same location, exclusive of the roll-on or roll-off points where the contact arm moves from the termination, on or off, the resistance element. The rate of rotation of the operating shaft shall be such that the wiper completes 1 cycle in 5 seconds, minimum, to 2 minutes, maximum.
 - 4.7.4 Integrity of shaft (not applicable to style RJR32)(see 3.10).
- 4.7.4.1 Mounting. Resistors shall be mounted on an appropriate mounting fixture with their bodies restrained from movement.
- 4.7.4.2 Pull force. A force of 5 pounds (for styles RJR12 and RJR24) and 2 pounds (for styles RJR26 and RJR28) shall be applied along the axis of the operating shaft, away from the body of the resistor. The force shall be maintained for a minimum of 1 minute.
- 4.7.4.3 Perpendicular force. A force of 2 pounds shall be applied in a direction perpendicular to the axis of the operating shaft for a minimum of 1 minute.
- 4.7.4.4 Examination after test. Resistors shall be examined for evidence of shaft breakage.



Rx - Test specimen.

Oscilloscope bandwidth: 100 Hz to 50 kHz.

Minimum imput impedance: At least 10 times the nominal resistance being tested.

NOTE: At the calibration of the decade, terminals 1 and 2 must be coincident. Calibration decade is to be set for the contact-resistance (CRV) level of the specified nominal resistance being tested.

FIGURE 3. Contact resistance variation measuring circuit.

- 4.7.5 <u>DC resistance (see 3.11)</u>. Resistors shall be tested in accordance with method 303 of MIL-STD-202. The following details shall apply:
 - a. Measuring apparatus The same measuring instrument shall be used for all resistance measurements in any one test, but not necessarily for all tests.
 - b. Test voltage Measurements of resistance shall be made by using the test voltages specified in table X. The test voltage chosen, whether it be the maximum or a lower voltage which would still provide the sensitivity required, shall be applied across the terminals of the resistor. This same voltage shall be used whenever a subsequent resistance measurement is made.

TABLE X. DC resistance test voltage. 1/

Total resistance, nominal	Maximum test voltage
Ohms	<u>Volts</u> 1.0
Over 100 to 1,000 incl	3.0
Over 1,000 to 10,000 incl	10
Over 10,000 to 0.1 megohm incl	30
Over 0.1 megohm	100

1/ The critical resistance value is the maximum standard resistance value which will dissipate full wattage when the maximum continuous working voltage is applied.

- 4.7.5.1 Total resistance. Total resistance shall be measured as specified in 4.7.5, between the resistance-element end terminals (terminals 1 and 3 on figure 1), with contact arm positioned against a stop. The positioning of the contact arm and terminal shall be the same for all subsequent measurements of the total resistance on the same specimen (see 3.11.1).
- 4.7.5.2 End resistance. The contact arm shall be positioned at the extreme counterclockwise limit of mechanical travel, and the resistance shall be measured as specified in 4.7.5 between the contact arm and the corresponding end terminal. The contact arm shall then be positioned at the extreme clockwise limit of the mechanical travel, and the resistance shall be measured as specified in 4.7.5 between the contact arm and the corresponding end terminal. During this test, precaution shall be taken to insure that rated current of the resistance element is not exceeded. Clockwise signifies the direction of rotation of the operating shaft when the resistor is viewed from the shaft end (see 3.11.2).
- 4.7.6 Immersion (not applicable to 1 type terminations) (see 3.12). The surface shall be cleaned of any foreign matter immediately before immersion.
 - a. Precondition The resistors shall be preconditioned in an oven at 125°C ±5°C for 13 ±2 minutes, or use a fluorocarbon bath maintained at 125°C ±5°C for a period of 1.5 ±0.5 minutes. Upon completion of precondition, allow resistors to stabilize to room temperature for approximately 13 ±2 minutes.
 - b. Immersion ~ The resistors (not to exceed 30 samples) shall be immersed (not to exceed 30 samples) into a bath of fluorocarbon held at 85°C +5°C. -0°C for a period of 60 seconds ±5 seconds. The resistor shall be completely submerged in the bath, with no part at a depth of less than 1 inch. Resistors shall be shaken for a maximum of 5 seconds and shall remain in the bath for a period of 1 minute ±5 seconds. Visually examine resistors for inadequate seals, as evidence by a continuous stream of bubbles emanating from any concentrated point on the resistor.
 - c. Dye penetrant verification A five piece sample of the product exhibiting inconclusive evidence of compliance to immersion requirements (see 3.12), shall be preconditioned in an oven stabilized at 125°C ±5°C for 13 ±2 minutes, or preconditioned in a fluorocarbon bath maintained at 125°C ±5°C for 1 minute ±5 seconds and immediately upon removal (within 5 seconds.), shall be submerged in a dye penetrant solution for 30 seconds minimum. The dye penetrant solution shall consist of 0.1 grams per liter, or equivalent, of a soluble stain dye such as crystal violet dissolved in deionized water maintained at room ambient. Upon removal from the dye solution, the sample shall be held at room temperature until external surfaces are dry. The sample shall be carefully opened and examined under 10X to 30X for evidence of dye penetration into the sealed cavity. Evidence of such penetration verifies loss of immersion seal, and lack of such evidence verifies compliance to the requirements.
- 4.7.7 Actual effective electrical travel (see 3.13). The actual effective electrical travel shall be measured by placing the resistor in a suitable device and circuit which will indicate both angular position of the operating shaft and voltage output. The actual effective electrical travel will be the number of turns or degrees of the operating shaft in which a change in contact-arm position gives a measurable change in voltage output.
 - 4.7.8 <u>Dielectric withstanding voltage (see 3.14)</u>.
- 4.7.8.1 Atmospheric pressure. The resistors shall be tested in accordance with method 301 of MIL-STD-202. The following details shall apply:
 - a. Special preparations The resistors shall be mounted on metal plates of sufficient size to extend beyond the resistor extremities, and in such a manner that measurements can be made between the terminals tied together and any other external metal parts.

- b. Magnitude of test voltage As specified in 3.1.
- c. Nature of potential From an alternating-current (ac) supply at commercial-line frequency and waveform. This potential shall be applied for 1 minute.
- d. Points of application of test voltage Between the terminals connected together and all external metal portions of the resistors and metal-mounting plate.
- e. Examinations and measurements During the tests, the leakage current shall be monitored and the resistors examined for evidence of arcing and breakdown. At the conclusion of the test, resistors shall be examined for evidence of damage.
- 4.7.8.2 <u>Barometric pressure</u>. Resistors shall tested in accordance with method 105 of MIL-STD-202. The following details and exceptions shall apply:
 - a. Method of mounting As specified in 4.7.8.1a.
 - b. Test condition C.
 - c. Period of time at reduced pressure prior to application of potential 1 minute.
 - d. Test during subjection to reduced pressure Voltage as specified (see 3.1) from an ac supply at commercial line frequency and waveform shall be applied for 1 minute.
 - e. Points of application As specified in 4.7.8.1e.
 - f. Examinations and measurements As specified in 4.7.8.1e.
- 4.7.9 <u>Insulation resistance (see 3.15)</u>. Resistors shall be tested in accordance with method 302 of MIL-STD-202. The following details shall apply:
 - a. Test condition A or B, whichever is more practicable.
 - b. Special preparation As specified in 4.7.8.1a.
 - Points of measurement As specified in 4.7.8.1d.
 - 4.7.10 Torque.
- 4.7.10.1 Operating. The torque required to move the contact arm on the resistance element shall be determined at approximately 10, 50, and 90 percent of actual effective-electrical travel by the torque-wrench method or by any other method acceptable to the Government (see 3.16.1).
- 4.7.10.2 <u>clutch</u>. The contact arm shall be adjusted to each extreme limit of mechanical travel, and sufficient torque shall be applied to the lead-screw actuator to permit the contact arm to idle for 25 complete mechanical turns of the lead-screw actuator. During idle, a suitable electrical indicating device connected between the contact-arm terminal and the adjacent end terminal shall be observed for electrical continuity. After idle, the operating shaft shall be rotated in the opposite direction. The indicating device shall be observed to determine if the contact arm reversed direction. (see 3.16.2).

- 4.7.10.3 <u>Stop (when applicable)</u>. Resistor shall be mounted by their normal mounting means. The contact arm shall then be rotated to each extreme limit of mechanical rotation, and the specified torque (see 3.1), applied through the operating shaft to the stop.
- 4.7.11 Thermal shock (see 3.17). Resistors shall be tested in accordance with method 107 of MIL-STD-202. The following details and exceptions shall apply:
 - a. Test condition F.
 - b. Measurements before cycling Total resistance and setting stability shall be as specified in 4.7.5.1 and 4.7.12, respectivily.
 - c. Measurements after cycling Setting stability, total resistance, and continuity shall be measured as specified in 4.7.12, 4.7.5.1 respectively. Continuity of the contact arm shall be verified by connecting a vacuum-tube voltmeter or suitable indicating device, between the contact arm terminal and the counterclockwise end terminal. The applied voltage shall be in accordance with table X.
 - d. Examination after test Resistors shall be examined for evidence of mechanical damage.
- 4.7.12 <u>Setting stability</u>. The contact arm shall be set at approximately 40 percent of the actual effective electrical travel. An adequate dc test potential shall be applied between the end terminals. The voltage between the end terminals, and the voltage between one end terminal and the contact arm, shall be measured and applied to the following formula:

Where:

- E1 = Voltage across one end terminal and the contact arm terminal.
- E2 = Voltage across the end terminals.

The difference between the initial measurements made before the environmental test and the measurement made after the test indicates the setting stability in percent.

- 4.7.13 <u>Solderability (see 3.18)</u>. Resistors shall be tested in accordance with method 208 of MIL-STD-202. The following detail shall apply: All pin terminals of each resistor shall be tested.
- 4.7.14 <u>Resistance-temperature characteristic (see 3.19)</u>. Resistors shall be tested in accordance with method 304 of MIL-STD-202. The following details shall apply:
 - Test temperatures As specified in table XI.
 - b. Measurements at the end of each period Total resistance shall be measured as specified in 4.7.5.1, (wiper against stop, measured through end terminals) at temperature maintained during the period.

TABLE XI. Resistance-temperature characteristics.

Sequence	Temperature C
2 2/	25 <u>1</u> / -15 -55
4 5 <u>2</u> /	25 <u>1/</u> 65 150

1/ This temperature shall be considered the reference temperature for each of the succeeding temperatures.
2/ Not applicable in quality conformance inspection.

Note: At the option of the manufacturer, the reverse sequence may be as follows:

- 1. Room temperature
- 2. +150 *3
- 3. Room temperature
- 4. -55 *3

4.7.15 Moisture resistance (see 3.20). The resistors shall be tested in accordance with method 106 of MIL-STD-202. The following details and exceptions shall apply:

- a. Mounting Resistors shall be clamped or otherwise mounted with terminals exposed on a stainless-steel panel of sufficient size to extend beyond the resistor extremities, and in such a manner as to allow electrical connections to be made to the terminals.
- b. Initial measurement Immediately following the initial drying period, total resistance shall be measured as specified in 4.7.5.1.
- c. Polarization and loading voltage The resistors shall be divided into two equal groups; one group shall be subjected to polarization and the other group to load.
 - (1) Polarization During steps 1 to 6 inclusive, a 100 volt dc potential shall be applied with the positive lead connected to the resistor terminals tied together, and the negative lead connected to the mounting plate.
 - (2) Loading voltage During the first 2 hours of steps 1 and 4, a dc test potential equivalent to 100 percent rated wattage shall be applied to the resistors.
- d. Test procedure The moisture resistance cycling requirements shall be as follows: For qualification inspection - 20 cycles; For group 8 inspection - 10 cycles. Every 6 months, the group B quarterly test shall be 20 cycles.

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- e. Final measurements Upon completion of step 6 of the final cycle, the resistors shall be removed from the chamber and air dried for one-half hour at room ambient conditions. Samples shall not be subjected to forced air drying. The total resistance and insulation resistance shall then be measured as specified in 4.7.5.1 and 4.7.9, respectively. The subsequent 24-hour conditioning period and measurements do not apply.
- f. Examination after test Resistors shall be examined for evidence of mechanical damage.
- 4.7.16 <u>Setability (see 3.21)</u>. The resistor wiper shall be set at approximately 30 percent, 50 percent, and 75 percent of mechanical rotation. A dc voltage of up to 2.5 volts shall be applied across the end terminals, and the wiper shall then be adjusted smoothly without abrupt voltage change at each test point. The setability error shall be within the limits specified.
- 4.7.17 Shock (specified pulse)(see 3.22). Resistors shall be tested in accordance with method 213 of MIL-STD-202. The following details and exceptions shall apply:
 - a. Mounting Resistors shall be mounted by their normal mounting means, with their bodies restrained from movement, on an appropriate mounting fixture.
 - b. Test leads Test leads used during this test shall be no larger than AWG size 22 stranded wire, so that the influence of the test lead on the resistor will be held to a minimum. The test lead length shall be no longer than necessary.
 - C. Measurements before shock Total resistance and setting stability shall be measured as specified in 4.7.5.1 and 4.7.12.
 - d. Test condition I.
 - e. Measurements during shock Each resistor shall be monitored to determine electrical discontinuity of the resistance element, and between the contact arm and element, by a method that shall at least be sensitive enough to monitor or register, automatically, any electrical discontinuity of 0.1 millisecond or greater duration.
 - f. Measurements after shock Setting stability and total resistance shall be measured as specified in 4.7.12 and 4.7.5.1, respectively.
 - g. Examination after shock Resistors shall be examined for evidence of mechanical damage.
- 4.7.18 Vibration, high frequency (see 3.23). Resistors shall be tested in accordance with method 204 of MIL-STD-202. The following details and exceptions shall apply:
 - a. Mounting As specified in 4.7.17a.
 - b. Test leads As specified in 4.7.17b.
 - c. Measurements before vibration As specified in 4.7.17c.
 - d. Test condition D.
 - Measurements during vibration As specified in 4.7.17e.
 - f. Measurements after vibration As specified in 4.7.17f.
 - Examination after vibration Resistors shall be examined for evidence of mechanical damage.

- 4.7.19 Salt spray (corrosion) (see 3.24). The resistors shall be tested in accordance with method 101 of MIL-STD-202. The following details shall apply:
 - a. Special mounting As specified in 4.7.15a.
 - b. Test condition A.
 - c. Examination after exposure Resistors shall be examined for corrosion and mechanical operation.
- 4.7.20 Resistance to soldering heat (not applicable to L type terminals)(see 3.25). The resistors shall be tested in accordance with method 210 of HIL-SID-202. The following details shall apply:
 - a. Measurement before test Total resistance shall be measured as specified in 4.7.5.1.
 - b. Test condition C.
 - c. Measurement after test One hour after completion of test, the total resistance shall be measured as specified in 4.7.5.1. Resistors shall be examined for evidence of mechanical damage.
 - 4.7.21 Low temperature operation (see 3.26).
- 4.7.21.1 Mounting. The resistors shall be mounted in such a manner as to allow electrical connections to be made to the terminals.
- 4.7.21.2 Procedure. Total resistance shall be measured as specified in 4.7.5.1. The resistors shall be placed in a chamber at room temperature. The temperature shall be gradually decreased to -55°C +0°C, -5°C within a period of not less than 1.5 hours. For quality conformance inspection only, and at the option of the manufacturer, the resistors may be placed in the chamber when the chamber is already at the extreme low temperature. After one hour of stabilization at this temperature, setting stability shall be measured as specified in 4.7.12. Full rated continuous working voltage (see 3.1 and 3.7) shall be applied for 45 minutes. The resistors may be loaded individually or in parallel. Fifteen +5, -0 minutes after removal of voltage, setting stability shall be measured as specified in 4.7.12. The temperature in the chamber shall be gradually increased to room temperature within a period of not more than 8 hours. The resistors shall be removed from the chamber, and maintained at a temperature of 25°C ±5°C for a period of approximately 24 hours. Total resistance shall be measured as specified in 4.7.5.1. Resistors shall then be examined for evidence of mechanical damage.
 - 4.7.22 High temperature exposure (see 3.27).
- 4.7.22.1 Mounting. The resistors shall be mounted in such a manner as to allow electrical connections to be made to the terminals.
 - 4.7.22.2 Measurements during test. Measurements shall be 250, +48, -0 hours.
- 4.7.22.3 Procedure. Total resistance and setting stability shall be measured as specified in 4.7.5.1 and 4.7.12, respectively. The resistors shall be exposed to an ambient temperature of 150°C +5°C, -0°C for a period of 1,000 ±8 hours. Not less than 2 hours after the end of the exposure period, setting stability and total resistance shall be measured as specified in 4.7.12 and 4.7.5.1, respectively. Dielectric withstanding voltage (at atmospheric pressure), and insulation resistance shall be measured as specified in 4.7.8.1 and 4.7.9, respectively. Resistors shall then be examined for evidence of mechanical damage.

4.7.23 Rotational Life (see 3.28).

- 4.7.23.1 Mounting. Resistors shall be mounted by their normal mounting means, on a .0625 inch thick, glass-base, epoxy laminate. The resistors shall be ganged in pairs, and each pair shall be connected in series, as shown on figure 4, so that a nominally constant current flows through the resistors, irrespective of the contact-arm position during the turning of the operating shaft.
- 4.7.23.2 Procedure. Total resistance shall be measured as specified in 4.7.5.1. A dc potential, equivalent to that required to dissipate rated wattage across the entire resistive element of resistors having the same nominal total resistance as those under test, shall then be applied as shown on figure 4. The operating shaft shall be continuously cycled through 90 to 100 percent of the actual effective electrical travel, at the rate of one cycle for 2.5 minutes, for the multiturn units and 5 seconds to 2 minutes for single turn units, for a total of 200 cycles. A cycle shall consist of travel through 90 to 100 percent of actual effective electrical travel and return to the starting point. At no time during this test shall the contact arm be allowed to idle at either end of the travel. After rotation, total resistance shall be measured as specified in 4.7.5.1. Resistors shall be examined for evidence of mechanical damage.

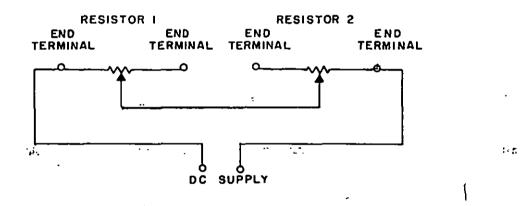


FIGURE 4. Rotational life test circuit.

4.7.24 Terminal strength (see 3.29).

- 4.7.24.1 <u>Pull (applicable to all terminal types)</u>. Resistors shall be tested in accordance with method 211 of MIL-STD-202. The following details and exception shall apply:
 - Test condition A. Applied force 2 pounds. Resistors clamped by the resistor body, force applied to each lead individually.
 - Measurement after test Resistors shall be examined for evidence of mechanical damage and tested for electrical continuity.

- 4.7.24.2 <u>Push (applicable to all teminals except type L)</u>. Resistors shall be tested in accordance with method 211 of MIL-STD-202. The following details and exceptions shall apply:
 - Test condition A, except force shall be applied in the direction toward the resistor body, force applied to each terminal individually.
 - Measurement after test Resistors shall be examined for evidence of mechanical damage and tested for electrical continuity.
- 4.7.24.3 <u>Bend (applicable to terminal types P, W, X, and Y only)</u>. Resistors shall be firmly clamped and each terminal shall be bent through 90° at a point .125 from the body of the resistor, with the radius of curvature at the bend approximately .03125 inch. The pin shall be returned to the original position, bent 90° in the opposite direction, and again returned to the original position. At the conclusion of the test, the resistors shall be examined for evidence of mechanical damage and tested for electrical continuity.
- 4.7.25 <u>Life (see 3.30)</u>. Resistors shall be tested in accordance with method 108 of MIL-STD-202. The following details and exceptions shall apply:
 - a. Method of mounting Resistors shall be mounted by their normal mounting means on a .0625-inch thick, glass base, epoxy laminate. The resistors shall be so arranged that the temperature of any one resistor shall not appreciably influence the temperature of any other resistor. There shall be no undue draft over the resistors.
 - b. Test temperature and tolerance 85°C ±5°C.
 - c. Initial measurement ~ Total resistance shall be measured as specified in 4.7.5.1.
 - d. Operating conditions Rated do or ac working voltage at commercial line frequency and waveform (see 3.1) shall be applied intermittently to terminal 1 and 3 of the resistor, 1.5 hours "on" and 0.5 hours "off" for the time duration specified in 4.7-25f. Each resistor shall dissipate rated wattage, but shall not exceed maximum voltage. Adequate precaution shall be taken to maintain the constant voltage on the resistor.
 - e. Test condition 2,000 hours for qualification with all samples continued to 10,000 hours.
 - f. Measurements during test:
 - (1) Qualification inspection Resistance (see 4.7.5), shall be measured at the end of the 0.5 hour "off" periods after 168 +48, -0; 504 +48, -0; 1,008 +48, -0, and 2,016 +72, -0 hours has elapsed. Units continued on test shall be measured at intervals above 2,000 hours in accordance with 4.7.25f(2).
 - (2) Extended life testing Resistance (see 4.7.5), shall be measured at the end of the 0.5 hour "off" periods after 168 +48, -0; 504 +48, -0; 1,008 +48, -0; 2,016 +72, -0, and every 2,000 +96, -0 hours thereafter, until the required extended life period (10,000 hours) have elapsed. Measurements shall be made as near as possible to the specified time but may be adjusted so that measurements need not be made during other than normal working days.
 - g. Examination after test Resistors shall be examined for evidence of mechanical damage.

- 4.7.26 Resistance to solvents (see 3.31). Resistors shall be tested in accordance with method 215 of MIL-STD-202. The following details shall apply:
 - a. The marked portion of the resistor body shall be brushed.
 - b. The number of sample units shall be as specified in tables VI and IX, as applicable.
 - c. Resistors shall be examined for evidence of mechanical damage and legibility of markings.
 - 4.7.27 Low temperature storage (see 3.32).
- 4.7.27.1 Mounting. Resistors shall be mounted by their normal mounting means and in such a position with respect to the air stream that the mounting offers substantially no obstruction to the flow of air across and around the resistors.
- 4.7.27.2 <u>Procedure</u>. Total resistance shall be measured as specified in 4.7.5. Within one hour after this measurement, the resistor shall be placed in a cold chamber at a temperature of -65 C ± 2 C for a period of 24 ± 4 hours. The resistors shall then be removed from the chamber and maintained at a temperature of 25 °C ± 5 C until thermal stabilization is achieved. Total resistance shall then be measured as specified in 4.7.5. Resistors shall then be examined for evidence of mechanical damage.
 - 5. PACKAGING
- 5.1 Packaging requirements. Resistors shall be prepared for delivery in accordance with MIL-R-39032.
 - 6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

- 6.1 <u>Intended use</u>. Resistors covered by this specification are intended for use in electronic equipment, and are used for matching, balancing, adjusting circuit variables in computers, telemetering equipment, and other critical applications.
- 6.2 Acquisition requirements. Acquisition documents should specify the following:
 - a. Title, number, and date of this specification.
 - b. Issue of DODISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.1).
 - c. Title, number, and date of the applicable detail specification sheet, and complete PIN (see 3.1).
 - Levels of preservation and packaging and packing, and applicable marking (see section 5).
 - e. Marking requirements for failure rate level and resistance temperature characteristic (see 3.33.4 and 3.33.5).

- 6.3 Qualification. With respect to products requiring qualification, awards will be made only for products, which are, at the time set for opening of bids, qualified for inclusion in the applicable qualified products list whether or not such products have actually been so listed by that date. The attention of the contractors is called to these requirements, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or purchase orders for the products covered by this specification. The activity responsible for the qualified products list is the US Army Laboratory Command; however, information pertaining to qualification of products may be obtained from the Defense Electronics Supply Center (DESC-E), 1507 Wilmington Pike, Dayton, OH 45444.
- 6.4 <u>Sequence for examinations, measurements, and tests</u>. The sequence for examinations, measurements, and tests should be in accordance with table XI, and are indicated by the following symbols:
 - B = Before test.
 - D = During test.
 - A = After test.
- 6.5 <u>Selection and use information</u>. Equipment designers should refer to MIL-STD-199, "Resistors, Selection and Use of", for a selection of standard resistor types and values for new equipment design. All applications and use information concerning these resistors are also provided in MIL-STD-199.
- 6.6 <u>High resistance and voltages</u>. Where voltages higher than 250 volts rms are present between the resistor circuit and grounded surface on which the resistor is mounted, or where the do resistance is so high that the insulation resistance to ground is an important factor. Secondary insulation to withstand the conditions should be provided between the resistor and mounting or between the mounting and ground.
- 6.7 <u>Mounting of resistors</u>. Resistors should not be mounted by their flexible wire leads. Mounting hardware should be used. Printed circuit types are frequently terminal mounted, although brackets may be necessary for a high shock and vibration environment.
- 6.8 <u>Resistance temperature characteristic</u>. Consideration should be given to temperature rise and ambient temperature of resistors under operation, in order to allow for the change in resistance due to resistance temperature characteristic.
- 6.9 <u>Reduction of power rating</u>. When only a portion of the resistance element is engaged, the wattage is reduced in directly the same proportion as the resistance.
- 6.10 <u>Stacking of resistors</u>. When stacking of resistors, care should be taken to compensate for the added rise in temperature by denating the wattage rating accordingly.
- 6.11 <u>MIL-R-22097 substitution data</u>. Resistors of this specification, regardless of the their failure rate designation, are substitutes for resistors of the same resistance value, tolerance, and performance characteristics specified in the inactive for new design detail specification of MIL-R-22097 as follows:

Substitute specification Detail specification inactive for new design

MIL-R-39035/2	MIL-R-22097/3
MIL-R-39035/2	M1L-R-22097/4
M11_D_30035/3	M11_0_22007/S

- 6.12 <u>Contact corrosion</u>. Contact corrosion may develop at the point where the wiper makes contact with the element, if a current of 25 microamps or greater is not maintained.
 - 6.13 Retinning leads. If retinning (hot solder dip) of the leads is required (see 3.5.11).
- 6.14 <u>Part or Identifying Number (PIN)</u>. PIN is a new term encompassing previous terms used in specifications such as part number, type designator, identification number, ect. (see 1.2.1).
 - 6.15 Subject term (key word) Listings.

Ohmic Potentiometer Resistance

6.16 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the exteniveness of the changes.

TABLE XII. Sequence for examinations, measurements, and tests.

	T					 _	
 Examination or	 Total resis-	 Contact resistance	 Dielectric withstanding	 Insulation resistance	Torque	Resistance measured	 Setting stability
test	tance	variation	lvoltage at latmospheric lpressure			terminals 1, 3, and contact arm	
Groups I Visual and mechanical	 	 					
examination Actual effective	Α .						
electrical travel	Í I	i I	 Atmospheric	-			
End resistance	j	į a	and Barometric	A	A		
Thermal shock	B, A						B, A
Group II Resistance temperature characteristic	 						İ
Moisture resistance	B. A	A .	 				' [
Group III Shock (specified		,		A .			
pulse) Vibration, high	В, А]	-			В, А
frequency Salt spray	B, A	A 	 		٨		В, А
(corrosion)	 			·			
Group IV Resistance to soldering heat (not applicable to terminal L) Life	В, А В, А	Ā	 A	 	 A	B, D, A	
Group Y Low temperature operation	B, A				A		8, A
Low temperature storage High temperature	В, А					j	
exposure	В, А	Α	A	۸	A		B, A
Group VI Rotational life Terminal strength	B, A	A		 			
Group VII Solderability (not applicable to terminal L) (immersion not applicable to		 - - - - -					
terminal L)	<u> j</u>						

APPENDIX

PROCEDURE FOR QUALIFICATION INSPECTION

10. SCOPE

- 10.1 Scope. This appendix details the procedures for submission of samples, with related data, for qualification inspection of resistors covered by this specification. This appendix is a mandatory part of the specification. The procedure for extending qualification of the required sample to other resistors covered by this specification is also outlined herein.
 - 20. APPLICABLE DOCUMENTS. This section is not applicable to this appendix.
 - 30. SUBMISSION
- 30.1 Sample. The sample size and test routine for each style shall be as indicated in table XIV.
- 30.2 Test data. When tests are to performed at a Government laboratory, prior to submission, all sample units shall be subjected to all of the tests indicated as nondestructive in table VI. Each submission shall be accompanied by the test data obtained from these tests. The performance of the destructive tests by the manufacturer on a duplicate set of sample units is encouraged, although not required. All test data shall be submitted in duplicate.
- 30.3 Description of items. The manufacturer shall submit a detailed description of the resistors being submitted for qualification, including material used for the resistance element, the type of coating or enclosure, and the material used for the housing and terminals. After qualification has been granted, no change shall be made in materials, design, or construction without prior notification to the qualifying activity.

40. EXTENT OF QUALIFICATION

40.1 Extent of qualification. The resistance range included in the qualification of any one resistor style will be between the highest and lowest resistance values inspected. Qualification of characteristic H is basis for qualification of F and C, qualification of characteristic F is basis for qualification of characteristic C. Characteristic C qualifies characteristic C only. Qualification of one terminal type may be extended to other terminal types provided the internal construction is the same and additional testing is performed in accordance with table XIV. The extent of qualification between failure rate levels shall be specified in table XIII.

TABLE XIII. Extension of qualification between failure rate levels.

	Will qualify failure rate level
S	S, R, P, M R, P, M
j p M	P, H

TABLE XIV. Qualification sample size and test routine.

Extension of qualification	Resistance value	Terminal type tested <u>1</u> / <u>2</u> /	Quarterly	Test routine
 Single terminal type submission over a range of resistance.	Highest Lowest	Type submitted 3/	24 24	Group I, IA. All samples then divided equally for groups III thru VI inclusive.
	Highest		6	Group II.
! 	Highest Lowest		51 51	Group I, IA and group VII.
			4	Group I, IA and group VIII (any value, any terminal type)
P, Y, W, and X type over a range of resistance.	Highest Lowest	P (or Y) P (or Y)	24 24	Group I, IA. All samples then divided equally for groups III thru VI inclusive.
	Highest Lowest	P (or Y) (W or X)	6 6	Group II
	Highest	(W or X)	24	Group I, IA. All samples then divided equally for groups III thru VI inclusive.
.	Highest Lowest Highest Lowest	P (or Y) P (or Y) C (or X) (W or X)	26 25 26 25	Group I, IA, and group VII.
			4	Group I, IA, and group VIII any value, any terminal type

See footnotes at end of table.

TABLE XIV. Qualification sample size and test routine - Continued.

Extension of qualification	 Resistance value	 Terminal type tested <u>1</u> / <u>2</u> /	 Quarterly 	Test routine
P, Y, and L type over a range of resistance.	Highest Lovest	 P (or Y) P (or Y) 	24 24	Group I, IA. All samples then divided equally for groups III thru VI inclusive.
_	 Highest	P (or Y)	6	Group II
_	Highest 	L	24	Group I, IA. All samples then equally divided for groups III thru VI inclusive.
	 Highest	 <u> </u>	26	Group I, IA and group VIII
	Lovest_	<u> </u>	25	•
	<u> Highest</u>	P (or Y)	26	<u>.</u>
-	Lovest	P (or Y)	25	
	 	· · · · ·	4	Group I, IA and group VIII any value, any terminal type.
P, Y, L, W, and X type over a range of	Highest	P (or Y) <u>3</u> /	24	Group I, IA. All sample then divided equally for groups
resistance	Lovest	P (or Y)	24	III thru VI inclusive.
٠.	Highest	P (or Y)	6	Group II.
·	 Highest	A, B, W or X	6	· ·
	Highest	L	24	Group I, IA. All samples then divided equally for groups
	Highest	A, B, W or X	 24	III thru VI inclusive.
	Highest	L	17	Group I, IA and group VII
	Highest	P (or Y)	17	
	 Highest	A, B, W or X	17	•
	Lovest	L.	17	
[]	Lovest	P (or Y)	17	
Ī	Lowest	A, B, W or X	17	!
- -			4	Group I, IA and group VIII (any value, any terminal type).

Terminal type "X" will qualify "W" and conversely "W" will qualify "X".

Terminal type "P" will qualify "Y" and conversely "Y" will qualify "P" by subjecting 6 sample units of any resistance value to visual and mechanical examination.

P, Y, L, W, X or D.

<u>3</u>/

CONCLUDING MATERIAL

Custodians:

Army - ER Navy - EC Air Force - 85 NASA - NA

Review activities:

Army - EL, MI, MU, Navy - AS, EC, OS Air Force - 17, 80 DLA - ES

User activities:

Army - AT, AV, ME Navy - MC Air Force - 19

Preparing activity: Air Force - 85

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Agent:

DLA - ES

(Project 5905-1205)